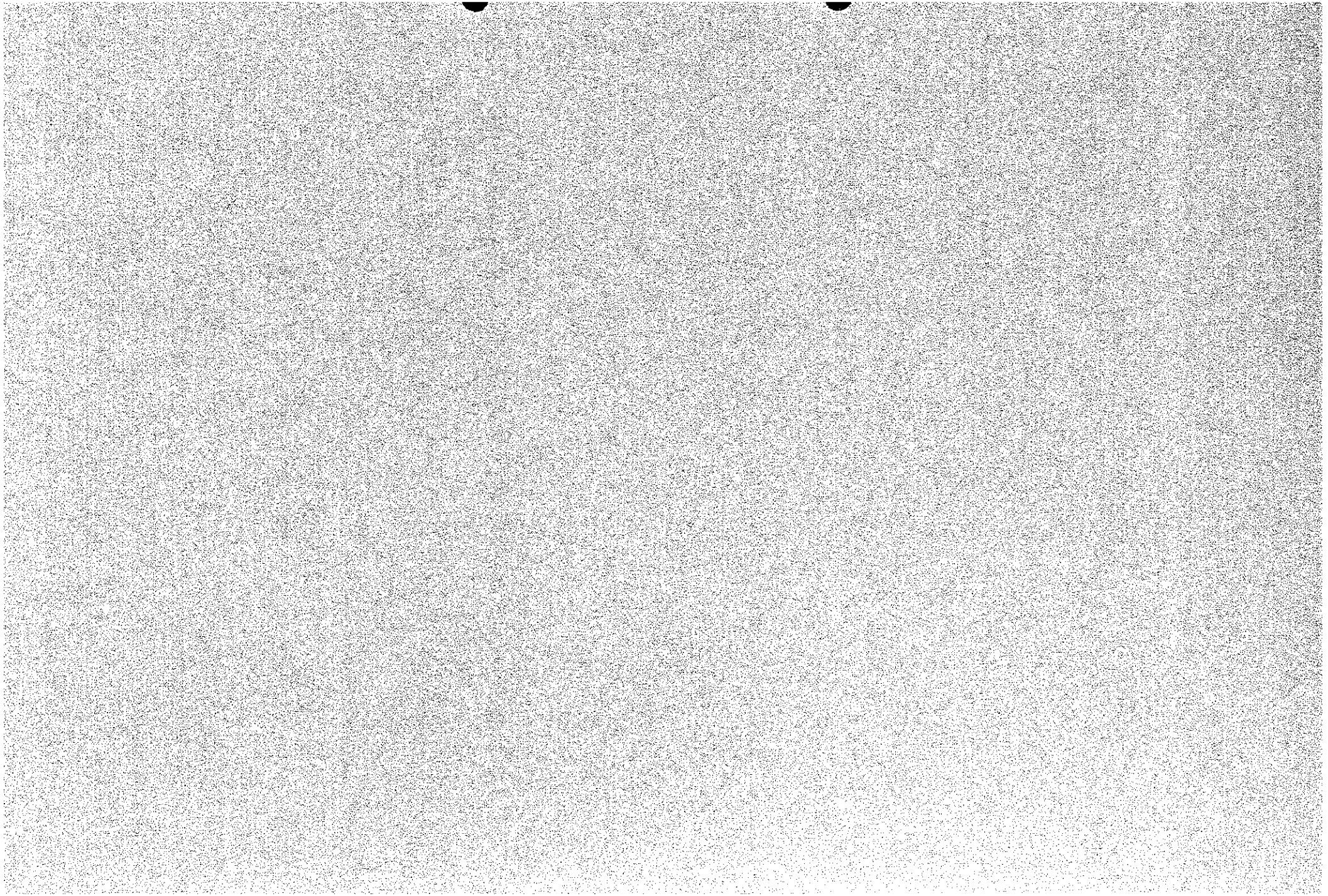
3. IMPLEMENTATION STATUS OF THE RECOMMENDATIONS IN THE "ENERGY CONSERVATION PROJECT IN THE KINGDOM OF THAILAND"



3. IMPLEMENTATION STATUS OF THE RECOMMENDATIONS IN THE "ENERGY CONSERVATION PROJECT IN THE KINGDOM OF THAILAND"

3.1 Study of the Energy Conservation Project In the Kingdom of Thailand

The Japan International Cooperation Agency (JICA) conducted a study on "Energy Conservation Project in the Kingdom of Thailand" with the National Energy Agency (NEA), the Ministry of Science, Technology and Energy in Thailand with its counterpart from 1982 to 1984.

The study and the recommendations covered the following.

1) Recommendation on the enactment of an energy conservation act and financial support measures, etc. to embody the policies for the promotion of energy conservation

2) Recommendation on the establishment of semigovernmental organizations for energy conservation promotion and on offering of specific technical supports to disseminate the energy conservation concept in the industrial field, etc.

3) The factory energy conservation study was conducted on 55 factories in 6 industrial subsectors as the model factories for energy conservation promotion in the industrial sector. As a result, energy conservation methods and guidelines were recommended, and the technology related to energy conservation improvement methods was transferred to the counterpart.

3.2 Implementation Status of Recommendations

(1) The Energy Conservation Act was enforced in April 1992.

a. Outline of the Energy Conservation Act

1) Factories and buildings consuming more energy than a certain standard should be designated and required to periodically submit their actual status of energy consumption as well as their energy conservation plans.

2) Designated factories and buildings should appoint energy managers, and submit a report thereof.
(Those who violate the rules in the item 1 and 2 above may be punished.)

3) The Energy Conservation Promotion Fund should be established to provide grants and subsidies to such plans for promoting energy conservation as described below:

① Investment for and implementation of energy conservation plans
② Research and development
③ Demonstration project

④ Education, training and meeting
⑤ Advetisement, information supply and PR services
⑥ Management of energy conservation promotion services

Also manufacturers and sellers of high-efficiency machines and equipment, facilities and materials are financially supported through this fund.

b. Significance of the enactment of the Act

1) With this enactment, the Government can give intensive energy consumers the idea of energy conservation, and instruct and encourage them to systematize and properly put the idea into practice.

Thus the Government can demonstrate its attitude that it places great importance on energy conservation.

2) The government can collect the data related to energy consumption to make them available to the future energy conservation project.

3) Its possible propagating effect is to enlarge the manufacture/sales business of the energy conservation equipment, facilities and materials and to develop a market for energy conservation consultant business.

Furthermore, it may contribute to offering more chances for employment as well as solving environmental problems.

(2) Establishment of the Energy Conservation Center of Thailand (ECCT)

In 1985 the Energy Conservation Center of Thailand was established under the leadership of the Federation of Thai Industries. At the time of its establishment, the fund of 40 million bahts was raised by the governmet and the private sector, to take the budgetary measure for rendering 8 million bahts per year for the limited period of 5 years from its establishment of ECCT.

ECCT conducts energy audit and energy management/training services which are entrusted by the Department of Energy Development and Promotion, as well as energy audit requested by enterprises, consultant service, P.R. activities, opening of seminars, supply of information, etc. with regard to energy conservation. Thus, EECT is highly evaluated in the industrial field as a core organ for implementing the promotion of energy conservation in Thailand.

(3) Others

In response to the recommendations, the following tasks as well as those mentioned above are conducted.

a. Energy audit

DEDP, ECCT, etc. conduct energy audit of factories and commercial buildings. So far they have made audit services for 2000 factories and buildings in total.

b. Training for energy management

Training courses for heat management, electricity management and energy management were provided at DEDP, ECCT, Chulalongkorn University, and Chiang Mai University, and 4,800 persons in total took lectures.

c. Opening of seminars for energy conservation

d. Information services for energy conservation technology

Information for energy conservation is provided to factories, commercial buildings, related organs and organizations through leaflets, pamphlets, posters, bulletins, etc.

e. Dissemination of information on energy conservation and arousing of consciousness for energy conservation

Information on energy conservation has been broadcast through video and television spot information.

f. Development and research on the energy conservation technology

Research and development were conducted on high-efficiency luminaire, freezer, electronic thermostats, ballasts, and reflectors for fluorescent lamps.

Moreover, research and development were also made on power generation by cogeneration, recovery of condensate drain, energy conservation in the ice-manufacturing industry and high-efficiency refrigerators.

g. Lowering of customs duties on the energy-conservation equipment

The government approved the lowering of import duties on 158 items (134 factories; 381 million bahts) of energy conservation equipment.

h. Low-interest loan

The Industiral Finance Corporation of Thailand (IFCT) finances energy conservation demonstration model projects at a special interset (Reference: the open market interest rate: 14 ~ 16%).

So far financing of 8.7 million bahts in total has been made on 8 factories.

4. ENERGY UTILIZATION STATUS FOR EACH INDUSTRIAL SECTOR

4. ENERGY UTILIZATION STATUS FOR EACH INDUSTRIAL SECTOR

4.1 Energy Consumption Status by Industrial Subsector

Figure 4.1 and Table 4.1 show the transition of the energy consumption by industrial subsector in the industrial sector.

Energy consumption in the overall industrial sector in 1993 was 2.3 times as large as that in 1984. Particularly, the growth of consumption in the Nonferrous Metals is outstanding.

Figure 4.1 Trend of Energy Consumption in the Industrial Sector

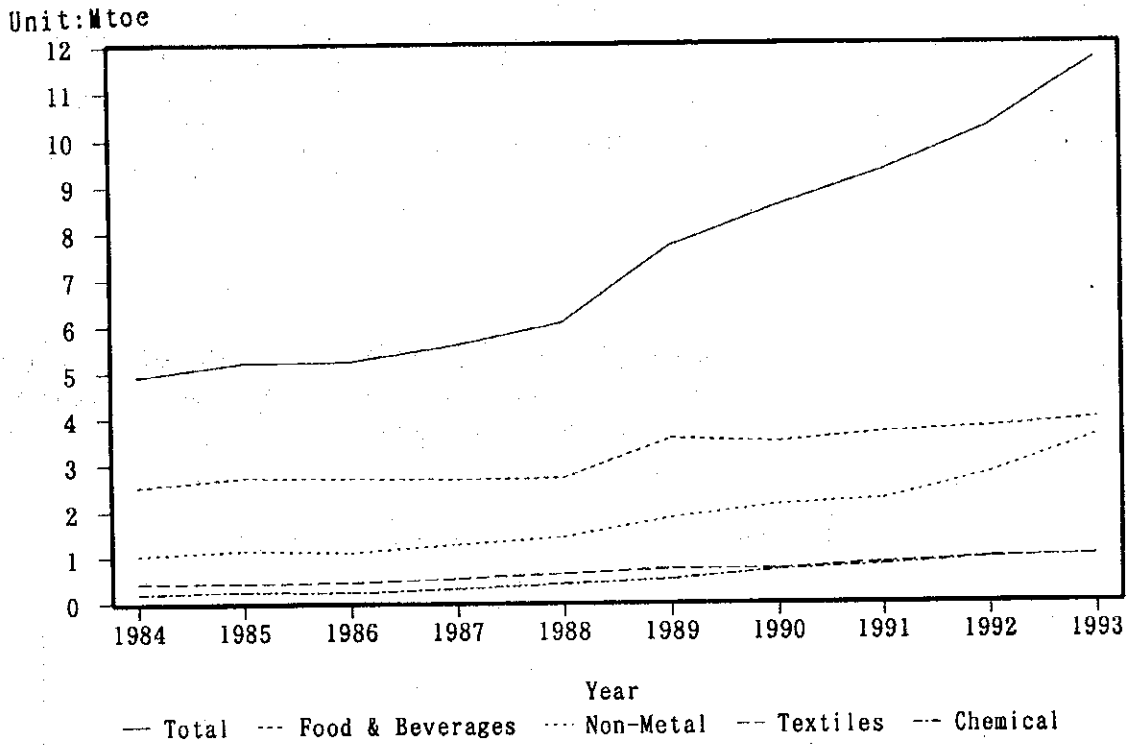


Table 4.1 Trend of Energy Consumption in the Industrial Sector

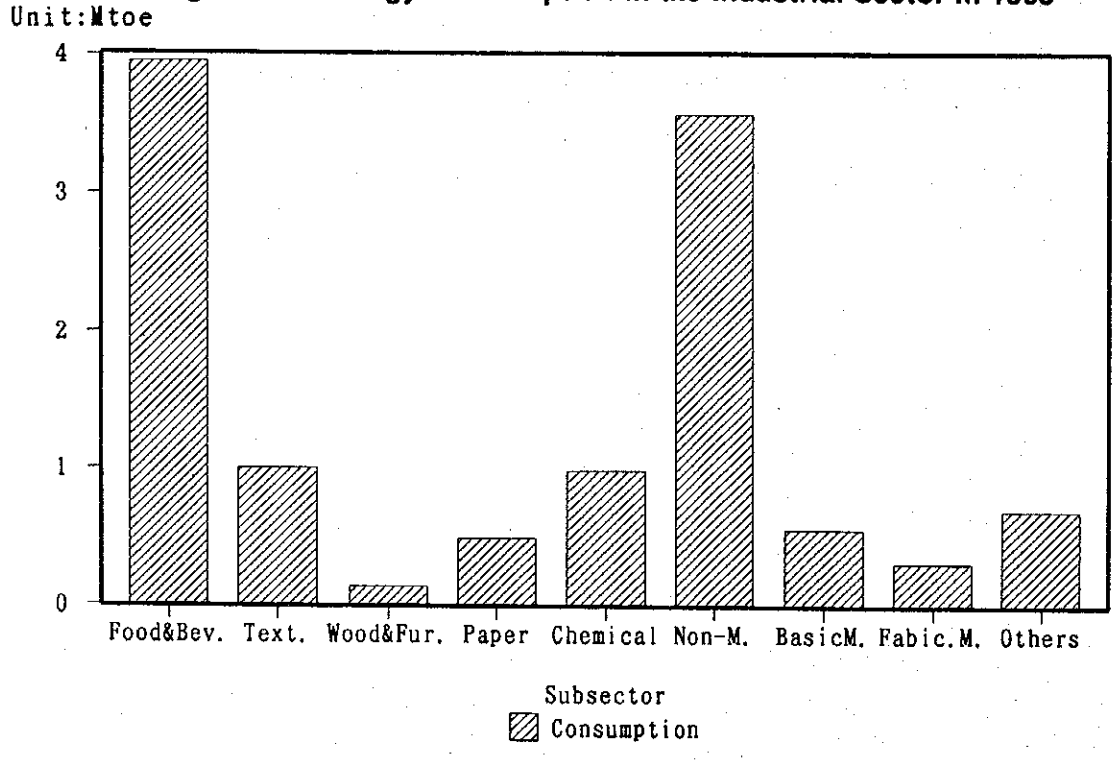
Unit:1000toe

Subsector	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Food & Beverages	2,536	2,730	2,710	2,675	2,704	3,542	3,483	3,673	3,782	3,954
Textiles	411	417	449	513	616	724	731	842	936	998
Wood & Furniture	37	52	63	71	87	87	81	85	103	129
Paper	120	177	168	216	244	305	305	390	360	490
Chemical	205	245	236	298	388	497	691	802	946	989
Non-Metalic	1,035	1,137	1,081	1,277	1,404	1,839	2,108	2,240	2,773	3,571
Basic Metal	182	179	191	199	224	278	329	381	510	555
Fabricated Metal	63	62	68	113	123	163	222	293	259	303
Others	340	220	283	237	272	277	591	582	569	698
Total	4,929	5,219	5,249	5,599	6,062	7,712	8,541	9,288	10,238	11,687

Source:Thailand Energy Situation 1993

Figure 4.2 shows energy consumption by industrial subsector in 1993. The great consumers include Food and Beverages and Nonferrous Metals. These two industrial subsectors consume approximately 64% of the energy in the overall manufacturing sector.

Figure 4.2 Energy Consumption in the Industrial Sector in 1993



4.2 Result of the Study on Energy Utilization Status in Factories and Buildings

The results on energy control and utilization status in factories and buildings that were surveyed upon the primary and secondary field studies are summarized below.

(1) Factories:

1) A Factory (Glass)
2) B Factory (Glass)
3) C Factory (Iron and steel)
4) D Factory (Cannery)
5) E Factory (Rice cleaning)
6) F Factory (Automobile parts)
7) G Factory (Plastic)
8) H Factory (Dyeing)

(2) Buildings:

1) a Building (Department store)
2) b Building (Department store)
3) c Building (Department store)
4) d Building (Bank)
5) e Building (Bank)
6) f Building (Hospital)
7) g Building (Hospital)
8) h Building (Hotel)

A. Factories

4.2.1 A Factory (Glass)

(1) Date/time of survey

August 23, 1993

(2) Interviewee

Factory Manager
Furnace Manager
Manager of Management

(3) Outline of the factory

Established in 1981 as a result of technical cooperation with Glass Manufacturer. It manufactures glass for fluorescent lamps and exports to Southeast Asia and Japan.

Ten engineers of NEC supervised construction for three years and one NEC engineer supervised the startup for five years. Presently, an NEC engineer is teaching quality control. The number of employees is 250.

(4) Major facilities

Glass furnace: Two (Melting with heavy oil, Forming with gas)
Soda furnace: One
Lead furnace: Two
Dust collector: EP
Transformer: One (1,000 kVA)

(5) Energy utilization status and energy conservation promotion status

Electric power: 380,000 kW/month
Heavy oil: 440,000 liters/month
Gas: 300,000 liters/month
Cullet in use: 30 to 45%
Lead glass: 320 tons/month
Soda glass: 800 tons/month

The unit energy consumption rate is higher than that in last year because the furnaces are old (4 to 5 years) and the cooling loss is high.

(Air/fuel ratio control is being planned. (An oxygen meter for waste gas is required.) The period of one power failure is 5 to 10 seconds. The energy cost is 30% for glass.

QC circle activities are implemented and presented once a month. These activities allowed energy saving of 300,000 kWh/year.

(6) Training of employees

Five persons in charge attended the training course (5 days) to be energy managers.

(7) Others

This factory will be a designated factory when the Energy Conservation Promotion Act comes into effect.

4.2.2 B Factory (Glass)

(1) Date/time of survey

October 20, 1993

(2) Interviewee

Engineering Manager
Chief of Electric Engineers
Chief of Measuring Engineers
Chief of Mechanical Division

(3) Outline of the factory

Established in August, 1990. The major product is glass bottles.

Glass bottle manufacturing process:

Raw material (cullet) → Melting furnace → Forming → Inspection → Packaging → Shipping
(No.1 220 tons/day,
No.2 250 tons/day,
installed in April, 1992)

(4) Electric power facilities

Transformer (power receiving): 2,000 kVa × 2, 1,500 kVa × 2, 1,000 kVa × 5, 500 kVa × 1

(5) Energy utilization status

Electric power used: 34,000,000 kWh/year (2,830,000 kWh/month)
Heavy oil (C grade): 18,500 kiloliters/year
LPG: 3,500,000 kg/year
Diesel oil: 2,000 liters/year (for forklifts)
Energy cost: Approximately 150,000,000 Baht/year (in 1992)

(6) Energy management status

a. Electric power contract: TOD contract

b. The percentage of the energy cost in the production cost can be calculated in the accounting department, but the other departments do not know it.

c. To report the energy utilization result after the Energy Conservation Promotion Act is enforced, energy data in the past three years is being analyzed.

d. The daily load curve of electric power can be created.

e. The energy conservation improvement plan for the entire factory can be created.

(7) Training of employees

Two persons attended the training course to be energy managers.

(8) Others (comment)

This factory is mainly based on thermal energies, using a large quantity of oil and LPG. Two glass melting furnaces which are the largest facilities are the most up-to-date energy conservation type facilities installed a few years ago. Moreover, operations are all controlled by computers in a centralized manner (optimal combustion control included).

For production facilities, excellent facilities and components are gathered from several countries. The quality of engineers is high in terms of facility engineering and manufacture engineering.

4.2.3 C Factory (Iron and Steel)

(1) Date/time of survey

August 23, 1993

(2) Interviewee

Mr. A

(3) Number of employees

600 (Total of No.1 and No.2 factories)
University graduates: 30, Technical college graduates: 180

(4) Major facilities

No.1 Factory: Electrical furnace, continuous casting (established in 1967)
No.2 Factory: Rolling, wire rod (established in 1979)
Electrical furnace: 180,000 tons/year: 25 tons/charge, 15 MVA - 2 sets,
Tap-to-tap time: 2 hours, 10 taps/day
Billet continuous casting machine: 110 × 110 × 3 st., Continuous casting series: 2 - 3
Rolling machine:
No.1 Factory: 19-50 mm, 75,000 tons/year
No.2 Factory: Wire 5.5-6.0 mm, 85,000 tons/year, Motor: Induction motor
Bar 9-25 mm, 95,000 tons/year
Transformer: 3,500 KVA (12 kV/3,300 V)
1,000 KVA (12 kV/380 V)
No independent power plant is provided.

(5) Energy utilization status and energy conservation promotion status

Rolling heating furnace No.7: 18 tons/hour, 2.8 mW × 20.8 milliliters,
Oil: 800 liters/hour, 1.8 - 2.0 GJ/ton
A used heat collector is attached to preheat the combustion air.
The used gas temperature is 258°C.

The energy cost is 36 to 37% (electric power: 16 to 17%, heavy oil: 20%). The energy consumption rate has increased because of the billet size change and operation shut-down.

(6) Training of employees

Two engineers attended the training course to be energy managers.
The qualification of the energy manager has no effect on his salary.

(7) Others

Reporting of the energy utilization result that is to be required by the Energy Conservation Promotion Act may be prepared in the factory. Preparation of the energy conservation improvement plan will be subcontracted to an external consultant.

4.2.4 D Factory (Cannery)

(1) Date/time of survey

August 30, 1993

(2) Interviewee

Mr. A
Mr. B

(3) Outline of the factory

Established in 1980. Merged with a Japanese company three years ago. The president is a Japanese. As the production processes, tuna is imported (95%), received, frozen, measured, cut (head and guts off, boiled by the cooker, then the skin and bones are removed. The products are food cans and feed.

The number of employees is 600 including 6 managers and 7 energy managers. The working hours are 8:00 to 17:00.

(4) Major facilities

Boilers: 3, 10-ton × 1, 3-ton × 2 (stand-by)
Freezing compressors: 90 kW × 2 (-8°C to -25°C, -30°C)
Transformer: 400 kVA, Peak demand: 520 kW
Emergency power generator: 60 kVA

(5) Energy utilization status and energy conservation promotion status

C heavy oil: 100,000 liters/month
Energy cost: 20%
Transition of energy consumption rate

	1990	1991	1992	1993
Fuel	988,500 kL	1,265.000	1,344.000	1,300.000
Electric power	968,133 kWh	1,535,200	3,389,880	2,500,000

Water: 36,900 B/month
8640 m^3/month
173 m^3/month (for office use)
Use of electric power and boilers is recorded every hour.
No control diagram or chart provided.

a. Boilers' efficiency is improved according to energy use audit conducted by the Department of Energy Development and Promotion (DEDP).
b. Heat insulation of the piping
c. Recycling of the condensate
d. Heat insulation of the cooker (planned)
e. Change of the capacity of fluorescent lamps from 40 W to 32 W
f. Use of transparent synthetic resin for the roof of the factory.

(6) Training of employees

Three persons in charge attended the training course to be energy managers.

4.2.5 E Factory (Rice cleaning)

(1) Date/time of survey

October 20, 1993

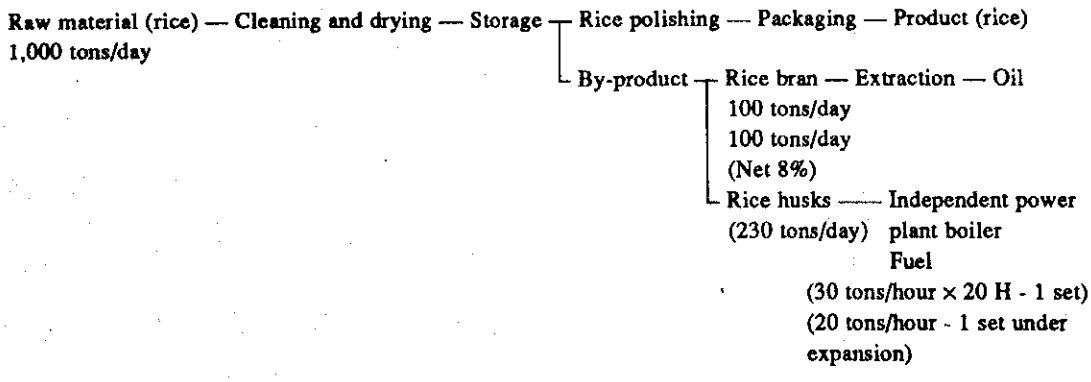
(2) Interviewee

Production Manager
Deputy Production Manager
Chief Engineer, Electrical Engineer

(3) Outline of the factory

Established in 1982.

Process flow:



(4) Major facilities

Independent power plant capacity: 1.45 MW × 2 sets
(At survey, one power generator was operating with less load because of the boiler in the off-normal condition.)
Transformer (power receiving): 1,000 kVA × 2 sets, 500 kVA × 1 set

(5) Energy utilization status and energy management status

a. As energy, electric power only is in use. (Purchased power and power generated by the independent power plant)

The factory is planned to expand; therefore the capacity of the independent power plant will be increased.

b. Electric power cost

Approximately 800,000 Baht/month (Demand Fee: 210 Baht/kW, Specific Fee: 1.7 Baht/kWh)

c. The percentage of the energy cost in the production cost is approximately 0.3%.
(500 Baht/Rice-ton, Energy cost: 25 Baht)

d. To comply with the Energy Promotion Act, they are preparing for enhancement of energy management.

e. The daily load curve of electric power can be created.

(6) Training of employees

Two employees attended the training course to be energy managers.

4.2.6 F Factory (Automobile parts)

(1) Date/time of survey

October 21, 1993

(2) Interviewee

Purchasing Manager
Maintenance Manager
Electrical Engineer

(3) Outline of the factory

- Established in 1977 as a result of expanding the automobile seat factory that had been in Bangkok since 1960.
- Major products are automobile seats, motorcycle parts (more than 50% parts can be manufactured), agricultural machine parts (engine), truck parts, automobile parts, television parts, and refrigerator parts. Production items have increased year by year.
- This company is a sub-manufacturer of a Japanese automobile parts manufacturer. It is one of three major sub-manufacturers in Thailand. The number of customers is approximately 40.
- This company is a member of the Thai A group.
- This company took energy audit by ECCT on September 28, 1992.
- The number of employees is approximately 2,500 (night shift: approximately 400) working on a 24-hour basis.

(4) Major facilities

Press machine
Spot welding machine
Welding machine
Seaming machine (welder)
Machining center
Injection machine

As energy, electric power only is consumed.

Transformers: 1,000 kVA × 3, 800 kVA × 1, 500 kVA × 1, 1,500 kVA (380 V) × 1, 1,500 kVA (200 V) × 1
Total : 7,300 KVA

(5) Energy utilization status and energy conservation promotion status

Contracted electric power: 2,000 kW
Electric power cost: 2,000,000 Baht/month (DC: 400,000 Baht)
Electric power: 1,000,000 kWh/month
Particularly, DC is high between 18:00 and 21:00 and it is approximately 300%.

- The highest electric power consumption is between 8:00 and 17:00 (exceeding the contracted power (2,000 kW) as measured by ECCT. Maximum 2,500 kW), the second is between 17:30 and 20:30 (1,500 kW to 1,600 kW), the third is between 21:00 and 24:00 (1,200 to 1,300 kW), and the lowest is between 20:00 and 8:00 (500 to 600 kW).

- For electric power measurement, a measuring equipment is provided at the secondary side of the transformer but electric power has never been measured. The ECCT's report concludes that electric power at the high DC portion should be cut down, so the company is making efforts for that target. Since the status is known, no measurement has been done.

- The power factor is controlled to be 85%. The voltage is also controlled.

- The company is very much interested in the demand controller.

- The percentage of the energy cost is seized by the accounting department.

- The QC committee is available. Presentations by employees are made once a year in a hotel.

- The failure rate is 1% or less. Training is made so that employees can check all parts.

- The 5S activity is enhanced at each place in the factory.

(6) Training of employees

Two persons attended the training course to be energy managers.

(7) Others (comment)

The best way of energy conservation in this factory is to improve productivity, which can be achieved by reducing the metal mold replacement time or supplying the material as a coil.

4.2.7 G Factory (Plastics)

(1) Date/time of survey

October 21, 1993

(2) Interviewee

Production Manager

(3) Outline

- This company was established in August, 1983. Presently, there are two companies in the factory. Initially, there was one company, which was recently divided into two companies. The production items and quantities are as follows:

Company name	Production item	Production quantity (tons/month)
A Factory	Soft leather	300 (material basis)
B Factory	PVC pipe	90 (material basis)

The soft leather (the most portion of the base is cloth) is used for automobile seats and chair covers.
The PVC pipe (material: waste PVC) is used for pipes of agricultural uses and cabling conduits.
Eighty (80) percent of the material PVC is waste, and standard products cannot be produced.

- Operations are done on a 24-hour basis.

(4) Major facilities

(A Factory)

24 kV power receiving transformer: 2,000 KVA × 1
100 to 300 HP motors: Approximately 20
Steam boilers (16-bar 130 to 160°C): 3.2 T/H × 1, 1.8 T/H × 1
Heated boilers (210°C) (heated by heating oil): 1.8 T/H × 1, 1.2 T/H × 1
For each boiler type, one boiler is operated and the other is a spare.

(B Factory)

24 kV power receiving transformer: 1,000 KVA × 1
Up to 100 HP motors: Approximately 10

(5) Energy utilization status

(A Factory)

Electric power cost: 450,000 Baht/month
Electric power used: 330,000 kWh/month
(Demand charge: 200,000 Baht/month)
Heavy oil cost: 134,000 Baht/month
Consumption: 60,000 liters/month

(B Factory)

Electric power cost: 150,000 Baht/month
Electric power used: 60,000 to 70,000 kWh/month

(A Factory only)

Percentage of the energy cost: Approximately 7.5%
Energy measurement interval:
Electric power – Measured every morning
Heavy oil – Measured when transferred from the storage tank to the settling tank.
(Three times a day according to the field record)
Energy cost/kg-material: 2.0 Baht
(Electric power cost: 1.5 Baht, Heavy oil cost: 0.5 Baht, which, however, do not match the ratio of absolute values between the electric power cost and heavy oil cost described above)

Checked once a month.
At the beginning of this year, one line was increased to two lines, each of which has a measuring equipment but each line is not separately measured.

The energy consumption rate tends to increase. The possible reasons are as follows:

① Full operations cannot be done because of economic recession. (16 tons/hour operations against 24 tons/hour facilities capacity)

② Insufficient engineers. Operations cannot be checked.

The 24-hour load curve has not been measured, but variation is assumed to be between 800 and 1,100 kW.

(6) Energy conservation measures

Examples in the past are as follows:

① Meters are individually installed in the lodging house for employees to control the use of electric power by employees. If a certain amount is exceeded, the charge is collected.

② Photo cells are installed for automatic lightings.

The steam-air heat exchanger for drying is cleaned once a year (using hydrochloric acid).
The air ratio of the steam boiler is 1.3.
For the heated boiler, exhaust gas O_2 is high and efficiency is low. Although heavy oil consumption can be reduced by decreasing O_2, preparation is delayed because of fund shortage.

(7) Training of employees

Three persons attended the training course to be energy managers. One of them has already retired.

4.2.8 H Factory (Dyeing)

(1) Date of survey

August 25, 1993

(2) Interviewee

Superintendent
Manager, Plant Engineering Department

(3) Outline of the factory

Established in 1964. This is a joint venture among a Japanese manufacturer and Thailand.
Number of employees: 435
Fifty percent of the product is exported.
Class 40 and 50 for cotton and tetron-cotton.
Cotton: 2,000,000 yards
Tetron: 4,000,000 yards

(4) Major facilities

The major electrical facilities such as transformer, power distributing panel, motor, and inverter are made by Meidensha.

Although no demand meter is provided, one set of relays is used.

The circuit breaker in use is the VCB. For the branch DS, an on-load circuit breaker is used.

For speed control, 1NV is used.

(5) Energy utilization status

Electric energy: 850,000 - 950,000 - 960,000 - 1,800,000 kWh/month (depending on the production)
Heavy oil: 950,000 to 960,000 liters/month
Gas: 150 to 160 kiloliters/month
Demand: 1,720 kW
Peak-time load: 2,000 kW

DF (off-peak)
Data is recorded three times a day (morning, noon, night).
Transformer capacity: 1,250 k, 1,500 k, 500 k
The above record is made every hour.
Energy cost: 13 to 14% (in sales amount)
Oil: Electric power: Gas=6:3:1
Water usage: 4,000 tons/day
A well in a 120 depth is provided but salt is contained.
Industrial water: 500 tons/day (for boiler)
Dryer temperature: Cotton 120 - 130°C steam
Tetron-cotton 220°C gas, infrared ray furnace

(6) Energy conservation measures

A big step of improvement was made by introducing the machines with Japanese know-how.

Inverter-type energy conservation machines for inverters are in progress. Replacement with new machines will be sequentially done.

Drainage from heavy oil and boilers is collected.

A heat exchanger is installed at some places.

Since there are many wetting and drying processes, process improvement (shortening the process time) is most effective for energy conservation.

Reduction of water usage and water recycling are positively in progress.

Voltage variation is large. A recuperator is attached to inverters.

(7) Others (comment)

Energy conservation measures should be started from cooling and air conditioning.

Also, drainage energy should be recollected, efficiency of the heat exchanger should be maintained, and the heat exchanger should be cleaned.

B. Buildings

4.2.9 a Building (Department Store)

(1) Date/time of survey

October 26, 1993

(2) Interviewee

Technique Service Manager

(3) Outline of the building

Completed: October, 1982
Total floor area: Approximately 32,600 m^2 (4,000 m^2/floor × 8 floors + 200 m^2/floor × 3 floors)
Construction: RC
Number of floors: 8 floors on the ground (partly 14-floor tower), Height: Approximately 55 m
Number of employees: Approximately 1,000 (plus approximately 1,000 tenants' salespersons)
Working hours: 10:00 to 22:00
Number of customers in a day: More than 100,000/day (average)

Many customers visit on the beginning days of a year, Saturdays, Sundays, and discount days.

The number of customers is larger from the end of every month to the beginning of the next month.

(4) Outline of facilities

(Electrical facilities)

- Transformer: 1,600 kVA × 2, 1,250 kVA × 1
- Lead-in voltage: 12 kV
- Power lines:
  Freezer line (1,600 kVA)
  Lighting, elevator, and pump line (1,600 kVA)
  Fan and escalator line (1,250 kVA)
- Electric charge: 2,000,000 Baht/month (Demand charge: Approx. 50%)
- Emergency power generator: 312.5 kVA × 1 (Rolls-Royce diesel + Power Pack)
  220/380 V, 475 Amp., 1,500 RPM, 50 Hz

(Air conditioning facilities)

- Freezer: Turbo freezer (made by Carrier) (Cool water outlet: 45 to 48°F)
  320 USRT × 3, 350 USRT × 1
  Cool water pump – 75 HP × 3, 25 HP × 1
  Cooling water pump – 50 HP × 3, 25 HP × 1
- Air conditioning method: Air-conditioner distributing
  AHU: 64 sets (20 to 40 USRT/set)
  External air is not taken in. (Draft from the entrance is used.)
  Ventilating fans are provided at the top of the well (started one hour before opening the store).
- Operating hours:
  9:00 AHU operation start
  9:30 Freezer (1) operation start
  10:00 Freezer (2) operation start
  10:30 Freezer (3) operation start
  11:00 Freezer (4) operation start (on Saturdays and Sundays as required)
  21:00 Freezer (1) operation stop
  21:30 Freezer (2) operation stop
  22:00 Freezer (3) operation stop (all lights turned off)

(5) Outline of building management

- Number of managers: 42
  Night: 4 to 5 persons standing by
  (plus approx. 30 guards and approx. 15 cleaning workers)
- Energy source:
  Electric power – Air conditioning, lighting, elevator, etc.
  Heavy oil – Emergency power generator
  LPG – Kitchen (centralized but no data available)
- Power consumption: The integrating wattmeter is read every 1.5 hours.
- Air conditioning temperature/humidity control:
  The set temperature is 24 to 25°C.
  The temperature is sometimes measured.
  (The temperature on the first floor is higher. The temperature on the second and higher floors is stable and appropriate.)
- Energy consumption rate: Not calculated.
- Efforts to save the electric charge:
  All the freezers are 100% run until 18:30, then one freezer is stopped to reduce the demand charge.
  So far, there is no problem in the temperature.
- Water usage: Not known.

- Lighting appliances: Basically, 36 W/piece. The number of appliances is not grasped.
- Energy conservation measures in the future:
  Presently, energy consumption is being measured. Measures will be planned according to the result.

(6) Training of employees

One or two persons attended the training course to be energy managers three times in the past.

(7) Comment

- Totally, the management system has been provided.
- For power consumption, that for the entire building is measured but each usage is not measured, so the measuring method should be improved or the estimating method for power consumption by usage should be examined.
- Although this is a large building, the method of taking in the outer air is not clear. Outer air intake control should be improved in terms of the air quality and energy saving.

4.2.10 b Building (Department Store)

(1) Date/time of survey

October 26, 1993

(2) Interviewee

Technical Section, Elec. & A/C
General Affairs Section

(3) Outline of the building

Completed: October, 1989
Total floor area: 39,700 m^2
Construction: RC
Number of floors: 8
Number of employees: Approximately 500 (plus approximately 1,500 tenants' salespersons)
Working hours: Weekdays – 10:30 to 21:30
Saturdays and Sundays – 10:00 to 21:30

Number of customers in a day:

Weekdays: Approximately 5,000/day

The number of customers is larger from the end of every month to the beginning of the next month.

Week end at the end of a month or discount days: Approx. twice

Week end in the middle of a month: Approx. 1.1 times

(4) Outline of facilities

(Electrical facilities)

Transformers: 3,000 kVA x 2
Lead-in voltage: 12 kV
Electric charge: 17,000,000 Baht/year (details not clear)
Electric usage: Air conditioning – 45%
Lighting – 30%
Elevator, escalator, lighting – 25%
Emergency power generator: 540 kVA (engine: DORMAN)
400 V, 1,500 RPM, 50 Hz

(Air conditioning facilities)

Freezer: Turbo freezer (made by Carrier)
900 USRT × 2
Air conditioning method: Air conditioner (AHU) and fan coil unit (FCU) distributing method (The number of sets is not clear.)
Operating hours:

One freezer is started 40 minutes before the store is opened.

The second freezer is started at noon (in summer only).

The freezer is stopped one hour before the store is closed.

(5) Outline of building management

Number of managers: 13 (No engineer is provided.)
Night: Two (night watch)(plus 22 guards)
Cleaning is done in the morning.
Energy source:

Electric power – Air conditioning, lighting, elevators (nine), escalators (16)

Heavy oil – Emergency power generator

Power consumption:

9,000,000 kWh/year

Daily load variation is not measured.

Recording is made every hour in working hours once every 15 days. (Simply recorded on a notebook.)

Air conditioning temperature/humidity control: The set temperature is 25°C.
Water usage: Not seized.
Energy conservation plan: Not provided at present.

(6) Training of employees

Employees attended the training course to be energy managers.

(7) Comment

The management system should be rearranged.
The checklist for components should be utilized.
Consciousness of energy cost saving should be aroused.

4.2.11 c Building (Department Store)

(1) Date/time of survey

August 19, 1993

(2) Interviewee

Mr. A

(3) Outline of the building

Completed: 1990
Total floor area: 75,000 m^2
Air conditioned area: 70,000 m^2
Number of floors: 14 floors on the ground (Floor 1 to 7: Shopping center, Floor 8 to 14: Offices)
Number of Employees: 3,000
Number of customers in a day: 30,000/day

(4) Outline of facilities

Transformers: 2,000 kVA × 6, 12 kV/220/380 V, Power factor: 0.85 or more
Emergency power generator: Legally not required (Emergency lamps: Battery operated)
Electric power usage: 12,000,000 kW (in 1992), increased by 10% since 1991 (because of remodeling, lighting, and air conditioning)
Peak-time electric power: 3,000 + 3,500 = 6,500 kW
Air conditioning freezers: 420 tons (3 × 1,000 + 1,200), 13 hours/day
Normally, two freezers are run. Three freezers are run on Saturdays and Sundays.
Boiler: Not provided

(5) Outline of building control

Electric power: Constant from 9:00. The air conditioning temperature is adjusted from 18:00.
Air conditioning: Fan coil cleaning (once a month)
Improvement proposal: Services to the customers
Record: kWh, A, kW, power factor (every 3 hours)
Energy consumption rate: Not calculated.
Temperature at the sales point: 25°C
Lighting: 300 to 500 Lux.

(6) Training of employees

Two persons in charge/shop attended the training course to be energy managers.

(7) Others

The fund for energy conservation promotion will be applied after requesting a consultant to survey the energy conservation improvement plan.

4.2.12 d Building (Bank)

(1) Date/time of survey

October 27, 1993

(2) Interviewee

Vice President
Electric Engineer

(3) Outline of the building

Completed: 1981
Total floor area: 16,276 m^2 (plus parking lot (14,423 m^2))
Air conditioned area: 14,048 m^2 (plus parking lot (1,280 m^2))
Construction: RC
Number of floors: 12 on the ground

(4) Outline of facilities

(Electrical facilities)

Transformers: 1,250 kVA × 2
Lead-in voltage: 12 kV
Electric power lines: Freezer and computer room line
Lighting, pump, and elevator line
Electric charge: 860,000 to 870,000 Baht/month (420,000 kWh/month)
Emergency power generator: 250 kVA × 2

(Air conditioning facilities)

Freezers: Turbo freezers (made by York)
275 USRT × 2 (standby)
550 USRT × 1 (renewed in January, 1993) (main)
Air conditioning method:
Air conditioners on each floor
(Two sets at east and west on each floor)
Outer air is taken in by the air conditioner, but the intake quantity is not seized.
Partially, split type air conditioners (100 sets) are used.
Operating hours:
6:30 to 18:30 (weekdays)
Split type air conditioners only are used on Saturdays, Sundays, and overtime working hours.
(Split type air conditioners are supplementarily used on weekdays.)

(5) Outline of building management

Number of managers:
13 (including one engineer)
① Air, pump, lighting, elevator
② Air conditioning
③ Communication, UPS, telephone
The people perform maintenance, design, and application jobs for 150 branches in the nation-wide area.
Energy source:
Electric power – Air conditioning, lighting, elevator
Heavy oil – Emergency power generator
Electric power consumption:
420,000 kWh/month
Power consumption of freezers is measured every hour by a computer.
The power factor is measured by the MDB on a batch basis.
Electric power usage: Air conditioning 50%
Lighting 50%

Air conditioning temperature/humidity control: Set temperature
Air conditioner room: A thermostat is installed in front of or inside the air conditioner room.
Office: No eaves, shades closed, heat absorbing glass, window open rate approx. 50%, slightly dark (approx. 500 Lux.)
Energy conservation measures:
Energy audit was carried out by DEDP.
The energy conservation activity was started aiming at energy cost saving.
This company is positive toward investment for energy conservation (i.e renewal of freezers).
Because of shortage of human resources, subcontracting to consultants is done.
Energy conservation measures in the future:
Transparent covers will be used for lighting appliances.
A reflection panel will be attached to each lighting appliance.
Replacement with energy conservation type lamps will be done.
(40 W, 20 W → 36 W, 18 W)

(6) Training of employees

The employees will attend the training course to be energy managers.
Some people took the seminar for energy conservation.

(7) Others (comment)

The management system has been provided anyhow.

Awareness of energy conservation is satisfactory, but the measuring method should be improved. (Measurement of electric power by usage, utilization of freezer operation data, etc.)

Although outer air is taken in by the air conditioner, control of the intake quantity is important for energy conservation.)

4.2.13 e Building (Bank)

(1) Date/time of survey

August 17, 1993

(2) Outline of the building

Completed: 1987
Total floor area: 25,185 m²
Number of employees: 1,400

(3) Facilities

Pump operating method: 2/4 units for the cooling tower
Freezers: 2/4 units. The cooling water piping is insulated by sponge. No hot water provided.
Air conditioning operating hours:
8:15 to 16:45 (Working hours: 8:30 to 16:30)
In other cases, air conditioning is done on the requested floor only. ON/OFF for each floor is possible.)
Room temperature: 24°C
Lighting: ON/OFF for each floor
Elevator: Inverter controlled
The control room is on the basement.

(5) Energy management status and energy conservation measures

Although the energy management system (monitoring) for the building is provided, it is not operating because the internal cabling is insufficient. Adjustment is planned. There are two systems; air conditioning and pump/extinguishing water.

Electric power record: Electric power (kWh) is daily recorded. There is no data relating to the outer air temperature and air conditioning power.

Power condenser: Automatic operation is impossible.

(6) Training of employees

Employees attended the training course to be energy managers, but there are no engineer and technician.

Excellent engineers are required. A consultant is needed to prepare the document to be submitted.

(7) Others

There is an energy conservation promotion fund available; however there are few human resources.

Although an energy conservation plan is provided, preparation will be done by a consultant.

4.2.14 f Building (Hospital)

(1) Date/time of survey

August 19, 1993

(2) Interviewee

Asst. Prof. A

(3) Outline

Completed: 1981
Total floor area: 5,530 m^2
Air conditioned area: 61% of the total floor area
Number of floors: 7 (Floor 7: Nurse school)
Number of beds: 200
Number of employees: 620 (Energy managers: 10)
Number of inpatients: 165
Number of outpatients: 850/day
Working hours: 24 hours

(4) Profile of facilities

Transformer: 800 kVA, 11 kV/220/380 V, Power factor: 0.85
Emergency power generator: Provided
Electric power usage: 3,000,000 kWh (in 1992), 250,000 kWh/month
Peak-time electric power: 480 kW. Peak time: 12:00 to 13:00
Air conditioner: 240 kW (268 separate units)
Elevator: 11 kW × 4, poll change
Auto crape: 12 kW × 2
Boiler: Not provided
Electricity: Air conditioning, lighting, medical components, computer, auto crape
Solar heat: Water warmer (for shower), 18 to 19 m^2, 50 - 55°C, Tank: 4 m^3

(5) Energy utilization status

Energy cost: 400,000 Baht/month, 1.7 Baht/kWh
Energy usage is increasing as a result of expansion of facilities.

(6) Energy control status

Usage (kWh) per month is recorded by each department. The cost meeting is held every month and the usage (kWh) and charge are announced.

(7) Energy conservation measures

The director is very much interested in energy conservation, so energy conservation activities have been implemented for four years.

a. Power factor improvement (0.8 → 0.85)
b. Transformer replacement (400 → 800 kVA)
c. Fluorescent lamp replacement (40 → 32 W)
d. Replacing incandescent lamps with fluorescent lamps (SL type) (Investment recovery: 4 to 5 months)
e. Installing the condenser of the air conditioner outside the building
f. Modification of the exhaust unit. A heat insulating material was added below the rooftop.
g. Replacing the air conditioner with a new type (20 sets/year)

4.2.15 g Building (Hospital)

(1) Date/time of survey

October 25, 1993

(2) Interviewee

Director
Deputy Director
Chief Maintenance

(3) Outline of the building

Completed: 1977
1987 to 1990 expanded
Air conditioned area: 14,000 m^2
Construction: RC
Number of floors: 22 on the ground, 1 basement floor
Number of beds: 500 (100 for children) (Usage rate: 100%)
Number of inpatients: 1,800/month
Number of outpatients: 1,000/day
Number of new-born babies: 500/month

(4) Outline of facilities

(Electrical facilities)

Transformers: 1,800 kVA × 2
Lead-in voltage: 12 kV (plus a low-voltage lead-in line)
Electric power line: Details not clear
Freezer line
Elevator and lighting line
Other lighting line
Electric power load peak time: 8:00 or 9:00
Electric power usage ratio:
Dynamic power for air conditioning, etc.: Approx. 60%
Elevator and lighting: Approx. 40%
Electric power usage: 619,440 kWh/month (Peak: 1,149 kW)
Electric power charge: 700,000 to 900,000 Baht/month
Emergency power generator: 312.5 kVA × 1
380 V, 475 Amp., 15,000 RPM, 50 Hz
Integrating wattmeter:
Freezer line – 1
Split air conditioner line – 1
Elevator line (2 groups) – 2
Entire building – 1

(Air conditioning facilities)

Freezers: Turbo freezers 300 USRT × 2
(Control panel: ISN Codepak Control Center)
Cool water outlet temperature: 45°F (7.1°C)
Air conditioning method:
① Air conditioner distributing method
(installed on the ceiling in each room, air supplied through duct)
② Ceiling-hung fan coil
Outer air is connected via the air conditioner or nothing is done.
③ Split air conditioner
ICU room, new-born baby room

(Sanitary facilities)

Water supply method: Elevated tank on Floor 21 plus the pump for pumping up
Steam boilers: 5 tons/hour × 2 sets (one set for standby) used for water supply, then dead weight water supply is done.
Steam usage: Restaurant, laundry, water heating
Fuel: D heavy oil (1,500 liters/day)
Operating hours: 4:00 to 18:00

(5) Outline of building management

Number of managers: 45 (on the night shift: 4)
Management recorded: Recorded every hour.
Energy consumption rate: Not calculated.

(6) Training of employees

Four persons attended the training course to be energy managers.

(7) Plan

Meters will be added so that water usage can be controlled per housing (or department)

Since scales heavily adhered on the water supply pipe, the piping was replaced.

The lighting facility should be improved (e.g. by removing the lighting covers).

(8) Others (comment)

Power consumption can be measured for each usage, which is favorable in energy management.

For taking in the fresh outer air, nothing other than natural ventilation seems to be done.

Although the sterilizing rooms are cooled by the fan coils, some of them are open. Outer air intake should be controlled.

The concept of setting the air conditioning temperature is insufficient. The room temperature control is the basis for saving the air conditioning energy.

4.2.16 h Building (Hotel)

(1) Date/time of survey

August 17, 1993
October 27, 1993

(2) Interviewee

Chief Engineer
Rooms Division Manager

(3) Outline

Constructed: 1983
Number of rooms: 343

(4) Facilities

Boilers: 2, 7 kg/cm², Water supply temperature: 70°C
Water heaters: 2
Freezers: 350 tons × 3, 400 tons × 1
Exhaust heat is recollected to use for the water heater.
Turbo freezer (made by Dunham-Bush)
Transformers: 2,000 kVA × 2 (for guest rooms and elevators) (for freezers) 12,000 V
Elevators: 7 (4 for guest rooms)
Common air conditioner: 1,000,000 Btu/hour
Emergency power generator: 470 kVA × 1 (made by Caterpillar)
Control system:
Made by Barber Coleman Co.
Energy Management System Micro/8000
ON/OFF of air conditioning and lighting is controlled.
Power consumption is not controlled.

(5) Management system

Number of management staff: 30 (Staff in charge of energy: 8)
Management by the headquarters:
The control department of the headquarters checks twice a year.
(30 in Asia, 160 in the world)

(6) Energy utilization status and energy conservation measures

Electric power usage: 780,000 kWh/month
Peak time: 1,600 kW (18:00), Average: 1,300 to 1,400 kW
Heavy oil usage: 1,000 liters/day
Record: Heavy oil usage. No record of the air/fuel ratio is available.
There is no practical energy conservation measures.
Guest rooms: Even unused rooms are always air conditioned.
Outer air is connected via the fan coil in the guest room and the same volume is exhausted from the bathroom.

(7) Training of employees

Persons in charge attended the training course to be energy managers.

(8) Others (comment)

The management system is anyway established.

Power consumption is measured three times a day (7:00, 15:00, 23:00), but each usage is not measured. Improvement is required to fully utilize the Micro/8000 functions.

Air conditioning of unused rooms is useless. It was explained that the set temperature is high, but actually it is not true. Some action will be required.

Outer air is taken in by the air conditioner, but outer air control depending on the number of customers should be considered.

5. ENERGY CONSERVATION ACTIVITIES IN THAILAND INCLUDING TRAINING AND EDUCATION OF STAFF

5. ENERGY CONSERVATION ACTIVITIES IN THAILAND INCLUDING TRAINING AND EDUCATION OF STAFF

5.1 Energy Policy

(1) Policy framework

Thailand has set out its energy policy framework in the 7th NESDP which started in October 1991, as follows:

① To promote petroleum and coal development, increase oil refining and power generation capacities, and promote the development of alternative energy sources to secure sustainable energy supply at stable prices.

② To reform energy-related regulations, promote the use of energy saving machinery and equipment, and encourage cooperative efforts among concerned organizations, conducive to efficient and economical use of energy.

③ To encourage private investment in oil business and electric utilities, and strengthen the financial position of national enterprises through privatization.

④ To reduce environmental release of lead, carbon monoxide, and sulfur dioxide in the process of energy consumption from a viewpoint of environmental protection.

⑤ To develop energy resources in rural regions for the benefit of fostering local industries.

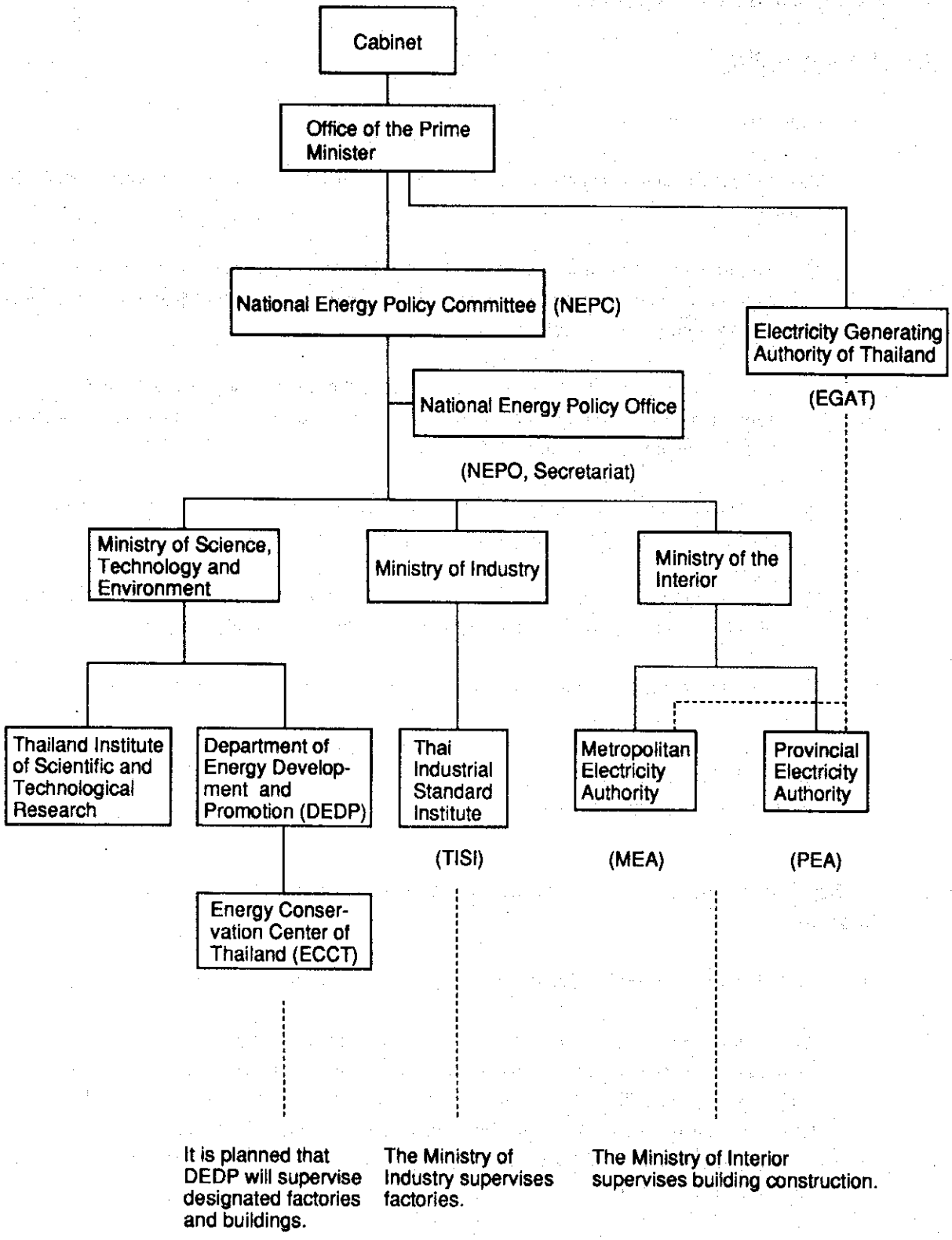
The plan also aims to maintain annual growth of energy supply below 8% and demand growth below 10% during the planning period between 1992 and 1996, while keeping import dependence ratio of energy sources under 60%.

5.2 Institutional Framework for the Implementation of Energy Conservation Measures

(1) Institutional Framework for Energy Policy Implementation and Coordination

Major energy policy matters are decided by the National Energy Policy Committee (NEPC, which is chaired by the prime minister and consists of ministers and vice-ministers of all ministries involved in energy policy). The committee's secretariat is the National Energy Policy Office (NEPO) and agencies concerned include the Ministry of Science, Technology and Environment, the National Economic and Social Development Board, and the Ministry of Industry. Fig. 5.1 shows the relationship of these ministries and agencies.

Figure 5.1 Relationship of Energy-related Ministries and Organizations



(2) Institutional Framework for Energy Conservation Promotion

Thailand started its efforts to promote energy conservation in 1981 when the Energy Conservation Center (ECC) was established as an organ in National Energy Administration of the Ministry of Science, Technology and Energy.

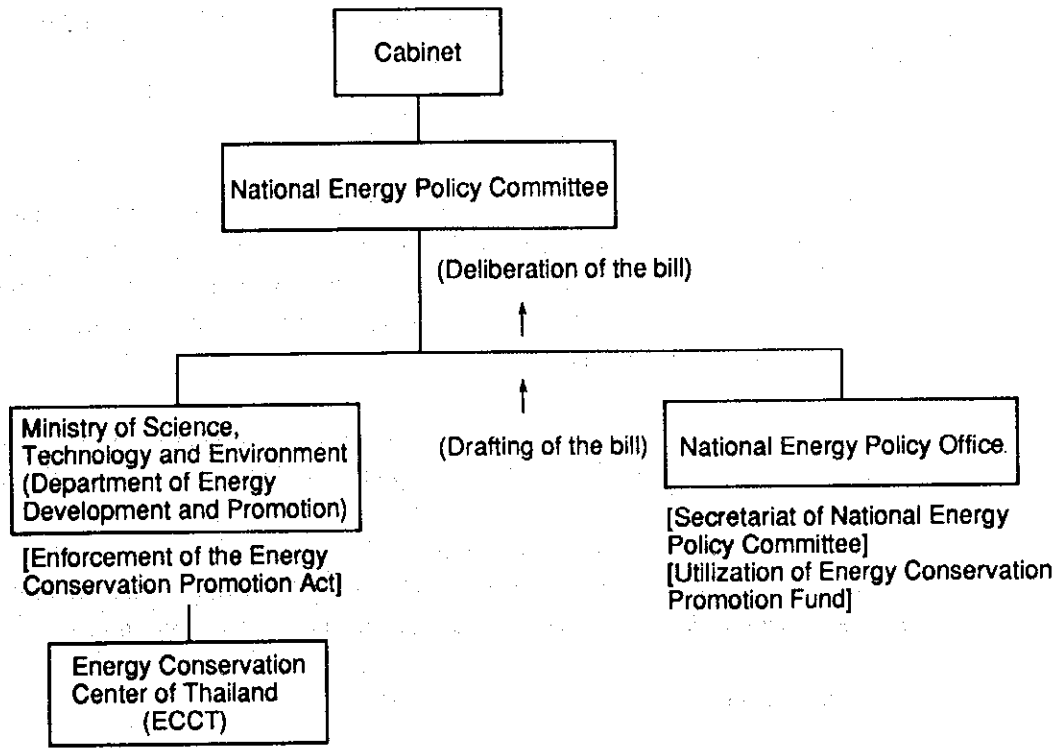
In 1985, with support from the Federation of Thai Industries and other organizations, the Energy Conservation Center of Thailand (ECCT) was established as a core organization for energy conservation promotion.

In April 1992, based on the 7th 5-year plan, the "Energy Conservation Promotion Act" was promulgated to establish an institutional framework for promotion of energy conservation in the country. At the same time, 1.5 billion bahts (about 6 billion yen) as the starting amount were transferred from the Oil fund to "Energy Conservation Promotion Fund", which is to be used as a financial source of low-interest loans and subsidies.

Figure 5.2 shows the relationship of the above organs.

In 1992, 28.7 million bahts (about 140 million yen) were appropriated from the national budget for energy conservation efforts.

Figure 5.2 Organizational Chart Related to Energy Conservation Promotion Act



(3) Organization and Duties of Department of Energy Development and Promotion (DEDP)

a. Positioning of DEDP in Energy Related Organization

In 1963, the first energy-related office in Thailand, the National Energy Administration, was established in the Office of the Prime Minister. After going through a series of changes, the office is now under the Ministry of Science, Technology and Environment as the Department of Energy Development Promotion (DEDP).

To set forth, coordinate, and implement energy policy, the National Energy Policy Committee (NEPC) was established with the prime minister in the chair and the National Energy Policy Office (NEPO) acting as its secretariat. DEDP plays a role of the executive organ of the Committee.

b. Organization, Staff and Budget

The DEDP consists of 11 divisions with staff of 3,823. It handles a variety of matters such as energy policy, alternative energy development, hydropower generation, geothermal power generation, design of dams, and joint development of the Mekong River. Among the departments, the Energy Conservation Division and Energy Economics Division deal with matters related to energy conservation with total staff of 115 (as of August 1993). The organizational charts of the Ministry of Science, Technology and Environment and DEDP are shown in Figures 5.3 and 5.4.

The department's 1993 budget is 3.5 billion bahts, out of which 36 million bahts are appropriated to energy conservation programs.

c. Energy Conservation Related Activities

The Energy Conservation Division is composed of 4 sections and works on planning of energy conservation programs, examining of energy conservation in factories and buildings, etc. Usually the teams of 6 staff members each conduct energy use audit service for 30 factories and 30 buildings a year. This program is intended to be implemented at 10,000 factories and 600 buildings in total.

The Energy Economics Division manages data which is collected from EGAT and other institutions and energy standards. The division also has the Energy Training Center.

Energy conservation evaluation and training activities are also conducted by the Energy Conservation Center of Thailand (ECCT) (with staff of 40) which was established as an auxiliary organ in 1985 with assistance of the Federation of Thai Industries.

d. Provincial Organs

There is no provincial organs established so far.

Figure 5.3 Organization of Ministry of Science, Technology and Environment

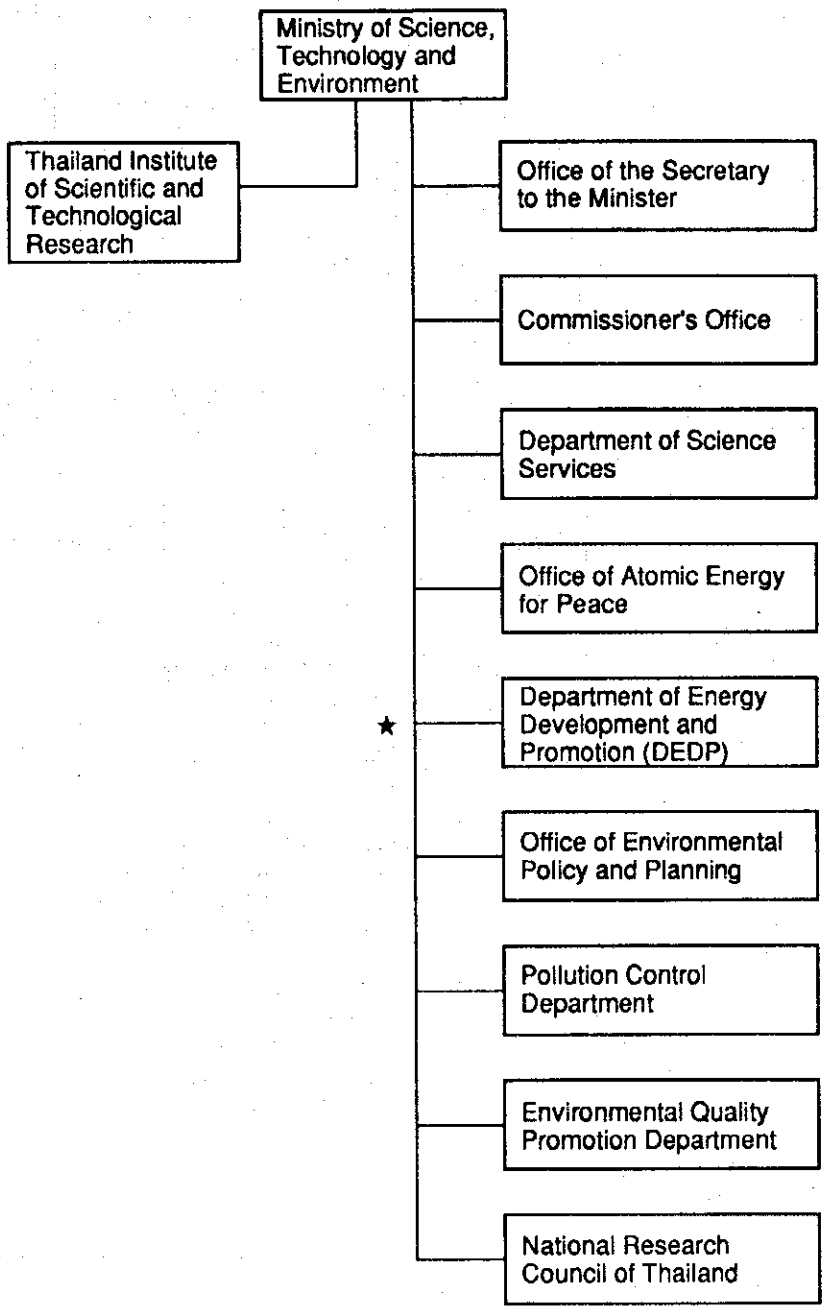
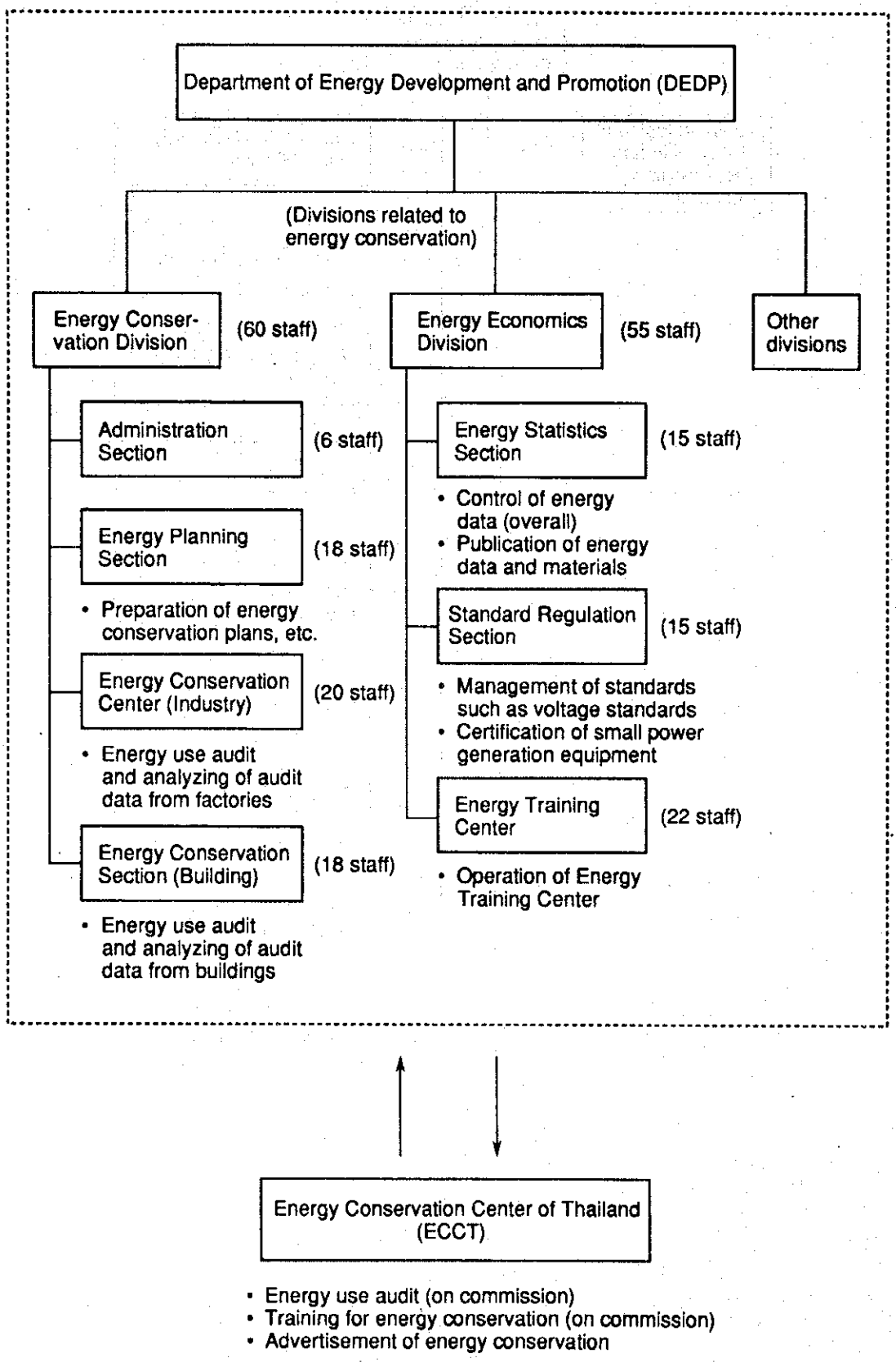


Figure 5.4 Departments and Divisions Related to Energy Conservation



5.3 Laws and Regulations Related to Energy Conservation

(1) The Energy Conservation Promotion Act

a. Background of the Energy Conservation Promotion Act

For Thailand which has heavily depended for its energy supply on oil imports, energy conservation is a policy priority to secure energy resources and save foreign currencies. For these purposes, the Government of Thailand drew up the "Energy Conservation Program of Thailand" in 1982. This program aims at securing reasonable and efficient use of energy through energy conservation technology and technology transfer.

In 1963, the National Energy Administration was set up in Office of the Prime Minister. After numerous changes, it was relocated in the Ministry of Science, Technology and Environment as Department of Energy Development and Promotion (DEDP) in 1992.

The department audits energy use in factories and buildings, provides education and training for staff related to energy conservation, carries out activities to disseminate knowledge of energy conservation, etc.

In addition, EGAT has been considering to conduct the Demand-Side Management (DSM) for last several years.

Despite of these efforts, the energy conservation program has not yet made satisfactory achievements. In the meantime, energy demand in the country has markedly increased since 1987 as the national economy expanded rapidly, which is causing some concern about future imbalance between energy demand and supply, together with difficulties in siting of new power sources due to environmental and other obstacles.

b. Enactment of the Energy Conservation Promotion Act

The 7th NESDP (1992 to 1996) points out the need to amend laws, rules and regulations for efficient energy use and conservation. Based on the Plan and against the above backgrounds, the "Energy Conservation Promotion Act" was enacted in April 1992. With this enactment, the government intended to give intensive energy consumers the idea of energy conservation, and instruct and encourage them to systematize and properly put the idea into practice.

The Act so operates to designate factories and building of a certain size to promote energy conservation, strengthening regulations such as requiring submission of energy consumption data and improvement plans, while providing financial aid to accelerate energy conservation through grants and subsidies with the Energy Conservation Promotion Fund.

c. Outline of the Act

The following are an outline of the Energy Conservation Promotion Act which is also summarized in Fig. 5.5:

1) Energy conservation should be encouraged for the following facilities with guidance:

① Factories

Efficient fuel combustion, prevention of energy loss, recovery of waste heat, improvement of energy conversion efficiency, efficient electricity use, etc.

② Buildings

Improvement of air conditioning, use of construction materials leading to energy conservation.

③ Energy-consuming machines and appliances

Standards for energy utilization and energy efficiency regulations

2) Factories and buildings which consume more energy than a certain standard are designated and required to report their actual status of energy consumption and energy conservation plans.

Notes:

- Electricity supply contracts of 1,000 kW or more and 20 million MJ/year or more are considered in the ministerial regulation.
- 3,600 establishments (3,000 factories and 600 buildings) are planned to be designated. The 3,000 factories consume 60% of the total amount of energy in the whole industry.
- The buildings include commercial buildings, offices, cinemas and hotels.

3) Energy managers should be appointed at designated factories and buildings.

Energy managers should be educated in training courses, etc.

Note: Energy managers must have one of the following qualifications:

① having a Higher Vocational Certificate and at least 3 years' experience in the factory;

② having a degree in Science or Engineering; or

③ completing a training course in energy conservation or training course with similar objectives organized or approved by the Ministry of Science, Technology and Environment.

4) The designated factories and buildings must record and report their actual use of energy every 6 months as well as prepare and submit an energy conservation improvement plan once a year.

Note: The energy use report must be submitted with the following data recorded in the prescribed form:

① Types and amounts of energy produced or used
② Energy unit consumption
③ Quantity of production

Energy managers of designated factories and buildings must analyze their use of energy, set energy conservation targets, and prepare and submit energy conservation plans.

5) The Energy Conservation Promotion Fund should be established to support plans to promote energy conservation with grants and subsidies.

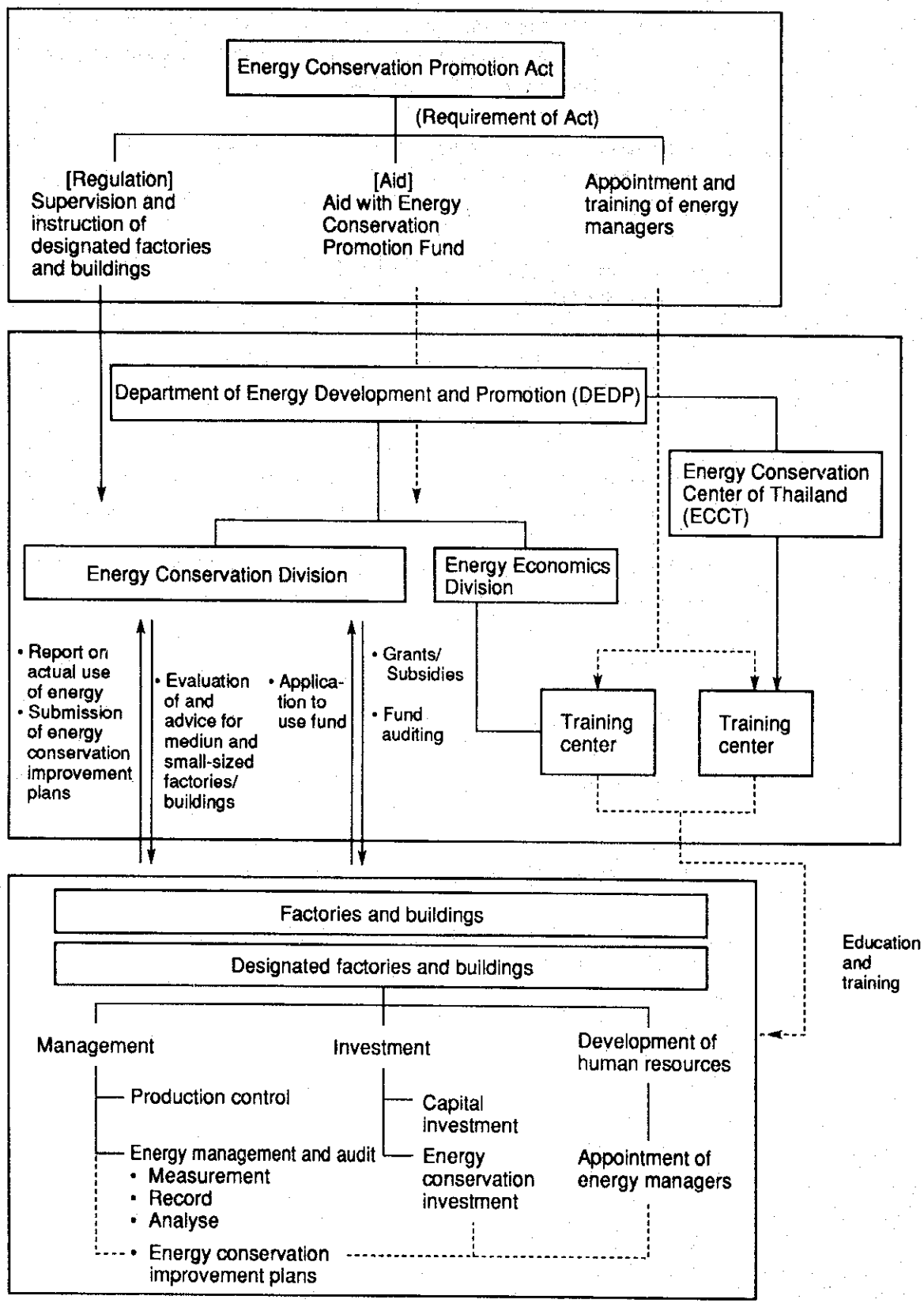
Notes:

- The fund includes 0.07 bahts/liter from gasoline, korosine, diesel oil and fuel oil.
- In addition to the original fund of 1.5 billion bahts, 2 billion bahts should be annually appropriated from petroleum products tax revenues.
- Undesignated factories and buildings may also use this fund.

6) Those who violate the above rules will be imposed electricity surcharges which will be collected by three electric power companies (EGAT, MEA and PEA).

7) Those who violate the above rules will be punished.

Figure 5.5 Requirements of Act and Current System



5.4 Implementation Status of Energy Conservation Activities

The Government and the related organs have so far conducted the following energy conservation activities to promote energy conservation in Thailand.

(1) Department of Energy Development and Promotion (DEDP)

a. Working out energy conservation policies and plans

b. Deciding on feasibilities for energy conservation

c. Working out guidelines and regulations for energy conservation

d. Supply of information on energy conservation technology

e. Energy audit

f. Implementation of training for the education of energy managers

g. Dissemination of energy conservation

(2) Energy Conservation Center of Thailand (ECCT)

ECCT conducts the following activities based on the project by the Department of Energy Development and Promotion (DEDP)

a. Energy audit (entrusted by DEDP)

b. Training for energy management (entrusted by DEDP)

c. Energy audit services entrusted by enterprises

d. Consultancy on energy conservation

e. P.R for energy conservation

f. Seminars for dissemination of energy conservation

g. Supply of information related to energy conservation

(3) Technological Promotion Association (Thai–Japan) (TPA)

a. Training for energy conservation

b. Workshop, seminars and study tours related to energy conservation

(4) Industrial Finance Corporation of Thailand (IFCT)

Financing of energy conservation plans at a special rate (11.5%)

(Reference: Open market rate 14 ~ 16%)

(5) Ministry of Finance (MOF)

Lowering of customs duties on machines and tools for energy conservation and environmental protection

(6) Universities (Chulalongkorn University, King Mongkut's Institute of Technology, Chiang Mai University, Prince of Song Khla University)

a. Research on energy conservation technology

b. Training for energy management